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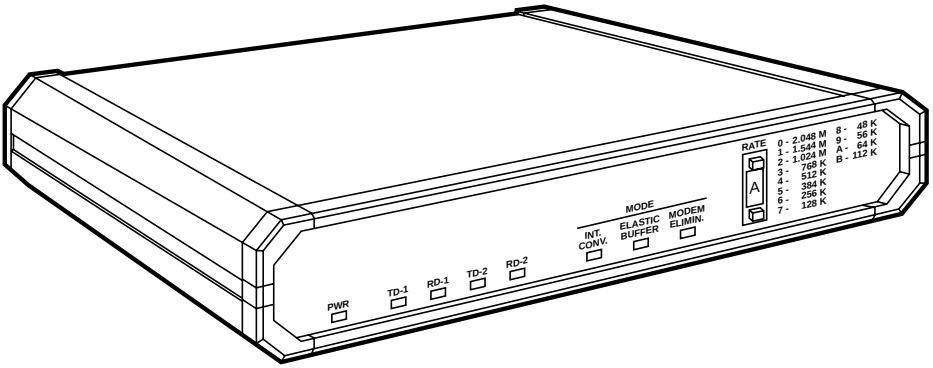
ME268C

Modular Modem Eliminator



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6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
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13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

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    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

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CONTENTS

Chapter **Page**

1. Specifications 7
1.1 Interface-Converter Mode 7
1.2 Modem-Eliminator Mode 7
1.3 Elastic-Buffer Mode 7
1.4 Connectors 7
1.5 Power 7
1.6 Physical Data 8
1.7 Environment 8

2. Introduction 9
2.1 Functional Description 9
2.2 Equipment Versions 9
2.2.1 Main Unit 9
2.2.2 Plug-in Interface Modules 9
2.2.3 Operating Modes 11
2.2.4 Timing Options for the Interface Modules 12
2.2.5 ITU G.703 64-kbps Codirectional Interface Module 14
2.2.6 ITU G.703 1.544-Mbps and 2.048-Mbps Interface Modules 16
2.2.7 General Characteristics 17
2.3 Applications 18
2.3.1 Interface-Converter Applications 18
2.3.2 Interfacing by General-Purpose Modules 20
2.3.3 Interfacing with 64-kbps Codirectional Interface Module 21
2.3.4 Interfacing with T1 or E1 Interface Module 22
2.3.5 Modem-Eliminator Applications 23
2.4 Elastic Buffer Applications 26

3. Installation 28
3.1 General 28
3.1.1 What's Included in the Package 28
3.1.2 Site Requirements 28
3.2 Configuration Information 29
3.2.1 General 29
3.2.2 Data Rate 29
3.2.3 Jumper Locations and Functions 30
3.2.4 Setting the Jumpers 32
3.3 Configuring Interface Modules 34
3.3.1 General-Purpose Interface Modules 34
3.3.2 ITU G.703 Interface Modules 34

CONTENTS (continued)

Chapter **Page**

3. Installation (continued)
3.4 Installing of Interface Modules 35
3.5 Connecting the Cables 36
3.5.1 Connector Locations 36
3.5.2 Data Connections 36
3.5.3 Power Connection 36
3.5.4 Grounding 37

4. Operation 38
4.1 Front-Panel Controls and Indicators 38
4.2 Operating Instructions 39
4.2.1 Power-On Procedure 39
4.2.2 Operating Instructions 39
4.2.3 Normal Indications 39
4.2.4 Power-Off Procedure 39

5. Troubleshooting 40
5.1 Things To Try 40
5.2 Calling Black Box 40
5.3 Shipping and Packaging 41

Appendix A: Interface Data 42
A.1 General-Purpose Modules 42
A.2 ITU G.703 Balanced Interface Modules 44

Appendix B: Calculation of Elastic Buffer Over/Underflow Rate 45
B.1 General 45
B.2 Slippage Rate without Buffers 45
B.3 Slippage Rate with Buffers 45

1. Specifications

1.1 Interface Converter Mode

Internal Data Rates—Up to 2048 kbps

Transmission Format—Synchronous

Transmission Mode—Full- or half-duplex

1.2 Modem Eliminator Mode

Transmission Format—Synchronous

Transmission Mode—Full- or half-duplex

Timing—*Internal Clock (selection by front-panel switch):* 48, 56, 64, 112, 128, 256, 384, 512, 768, 1024, 1544, and 2048 kbps; *External Clock:* Up to 2048 kbps, RTS/CTS Delay: 0, 6, or 51 msec, separately selected by jumpers for each interface, DCD: Continuously ON or controlled by the RTS signal, separately selected by jumpers for each interface

1.3 Elastic Buffer Mode

Transmission Format—Synchronous

Transmission Mode—Full- or half-duplex

Buffer Size—2 buffers, 256 bits each

1.4 Connectors

Modular Modem Eliminator Connectors—

Interface Module Connectors—*ME261C:* (1) DB25 female; *ME262C:* (1) 34-pin female; *ME263C, ME267C, ME268C:* (1) DB15 female; *ME265C:* (1) DB37 female; *ME266C:* (2) BNC (unbalanced interface)

1.5 Power

Power—*ME260A:* 115 VAC, 60 Hz, 5 watts; *ME260AE:* 230 VAC, 50 Hz, 5 watts

1.6 Physical Data

Size—*ME260A, ME260AE:* 1.7"H x 10.5"W x 9.6"D (4.4 x 2.7 x 2.4 cm); *Interface Modules:* 2.7"H x 0.06"W x 3.9"D (7.0 x 0.1 x 9.9 cm)

Weight—*ME260A, ME260AE:* 4.1 lb. (1.9 kg); *ME261C, ME263C:* 2.4 oz. (70 g); *ME262C:* 4.0 oz. (115 g); *ME265C:* 2.6 oz. (75 g); *ME266C:* 3.2 oz. (90 g); *ME267C, ME268C:* 2.8 oz. (80 g)

1.7 Environment

Temperature—32 to 122°F (0 to 50°C)

Humidity—Up to 95%, non-condensing

2. Introduction

2.1 Functional Description

The Modular Modem Eliminator is a universal interface converter that can be used to interface between two synchronous data communication equipment units that have incompatible interfacing characteristics. For this purpose, the Modular Modem Eliminator can perform the function of an Interface Converter, Modem Eliminator, or Elastic Buffer. You select the required function, and you can easily change the function whenever system requirements change.

2.2 Equipment Versions

For maximum flexibility and versatility, equipment construction is modular, and consists of one main unit and two plug-in interface modules. The plug-in modules can be easily changed in the field, whenever the interface on either side must be changed.

2.2.1 Main Unit

The main unit includes the internal power supply and the central control circuits. The main unit is available in two models:

- Modular Modem Eliminator, 115 VAC (part number ME260A)—this model can operate at data rates up to 2048 kbps. For applications that require the use of the Modular Modem Eliminator internal clock source, the available data rates are 48, 56, 64, 112, 128, 256, 384, 512, 768, 1024, 1544, and 2048 kbps. For applications that do not require the use of the internal clock (interface conversion, for example), the Modular Modem Eliminator can operate at any rate up to 2.048 Mbps.
- Modular Modem Eliminator, 230-VAC (part number ME260AE)—this model is identical to the ME260A, except that it operates at 230-VAC.

2.2.2 Plug-in Interface Modules

The interface modules perform the interface conversion and, where applicable, (for ITU G.703 modules) the extraction of the clock signal. There are two groups of interface modules: general-purpose interface modules and G.703 interface modules.

General-Purpose Interface Modules

The general-purpose interface modules are:

- RS-232 Module (part number ME261C), EIA RS-232 (ITU V.24)
- V.35 Module (part number ME262C), ITU V.35
- X.21 Module (part number ME263C), ITU X.21/V.11
- V.36 Module (part number ME265C), EIA RS-449/RS-422 (ITU V.36/V.11)

These modules provide the corresponding electrical and physical interface. The timing (clock) signals are transparently handled (via level converters, as for the other interface signals). To enhance Module universality and allow operation in various applications without requiring a cross cable, each of these interface modules has a switch that selects between DTE and DCE operation. Note that this switch also affects the flow of timing signals.

ITU G.703 Interface Modules

These interface modules provide ITU G.703 interfaces:

- G.703 (2 BNC) (part number ME266C), 64-kbps co-directional interface
- G.703 (DB15) (part number ME267C), 2.048-Mbps interface
- G.703 (DB15) (part number ME268C), 1.544-Mbps interface

Each G.703 interface module includes the corresponding line driver and line receiver, clock-recovery functions, and a jitter attenuator. The G.703 1.544-Mbps interface module uses B8ZS line coding, and the G.703 2.048-Mbps interface module uses HDB3 coding.

The timing of the receive path is always derived from the recovered line signal, whereas the timing of the transmit path can be selected via user jumpers in accordance with system clock distribution requirements: locked to the recovered receive clock ("loopback" timing), locked to the external clock, or an internal oscillator.

You can choose any pair of interface modules, which means you can use any combination of interfaces, as long as the technical limitations of the interfaces (as specified in the applicable standards) are observed.

NOTE

The EIA RS-232 (ITU V.24) interface cannot be used at rates higher than 64 kbps. Therefore, ITU G.703 T1 (ME268C) and E1 (ME267C) interface modules can only be used with the ITU V.35 (ME262C), EIA RS-449/RS-422 [ITU V.36/V.11] (ME265C), and ITU X.21/V.11 (ME263C) interface modules.

2.2.3 Operating Modes

The Modular Modem Eliminator has three operating modes, which are described below.

Interface-Converter Mode

The interface-converter mode lets you connect a Data Terminal Equipment (DTE) device to a Data Communications Equipment (DCE) device that has a different interface. A physical and electrical conversion between the DTE and DCE interfaces is performed. The data rate is determined by the equipment connected to the Modular Modem Eliminator.

Modem-Eliminator Mode

In the modem-eliminator mode, the Modular Modem Eliminator is used to connect two DTEs, thereby replacing two synchronous modems. The interface-conversion function of the Modular Modem Eliminator allows connecting even DTEs with different interfaces, in addition to the modem-eliminator function.

In this mode, the Modular Modem Eliminator fully emulates the operation of two modems connected in a link (one for each DTE). This includes supplying clock signals and handshaking control signals. The data rate is derived from an internal oscillator, and is selected by means of a front-panel switch. Any standard rate in the range of 48 kbps to 2048 kbps can be selected.

Both modules can also use external timing: With external timing, the Modular Modem Eliminator accepts an external clock in the range of 1.2 to 2048 kbps. This permits the transfer of system timing from one side to the other (clock locking). The maximum range that can be achieved depends on the interface type, cable type, and data rate, and can be up to 330 feet (100 m).

Elastic Buffer Mode

The elastic buffer mode is used to connect two independently clocked plesiosynchronous DCEs via FIFO buffers. By providing bi-directional buffering of data, the Modular Modem Eliminator reduces loss of data that would otherwise occur because of the difference in clock rates. The two DCEs can have similar or different interfaces, and the data rate can be up to 2048 kbps.

2.2.4 Timing Options for the Interface Modules

The timing options offered by the Modular Modem Eliminator depend on two factors:

- Types of interface modules installed in the Modular Modem Eliminator (general purpose, or ITU G.703), and the settings on these modules.
- Modular Modem Eliminator operating mode.

This section covers the timing options offered by the various interface modules.

For information on the timing options available in each operating mode, refer to **Sections 2.2.5** and **2.2.6**.

General-Purpose Interface Modules

The timing mode of a general-purpose interface module is selected via the DCE/DTE switch of the module:

- DCE—the interface module supplies clock signals for the receive and transmit paths. For the X.21 interface, the module provides only a transmit clock signal, and expects to receive data from the DTE at the same rate. **Figure 2-1** shows the flow of timing signals for the DCE mode.

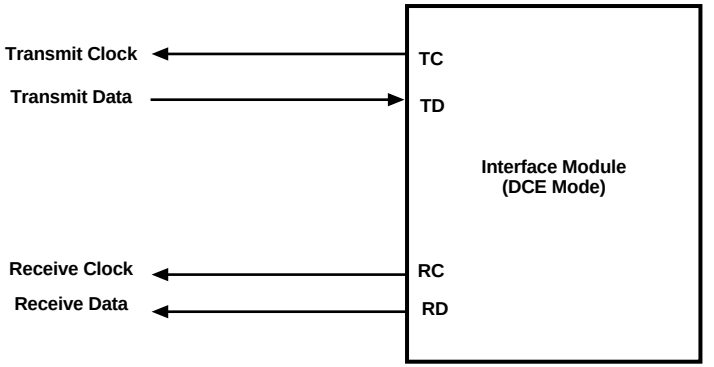

Figure 2-1. Flow of timing signals for DCE mode.

- DTE—the interface module accepts clock signals for the receive and transmit paths. Note that for the X.21 interface, the module has only a receive clock input. **Figure 2-2** shows the flow of timing signals for the DTE mode.

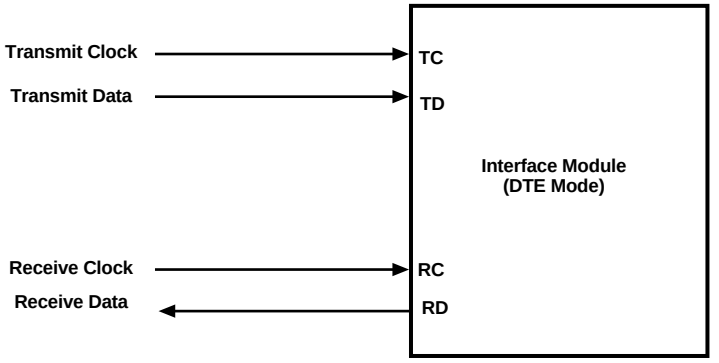

Figure 2-2. Flow of timing signals for DTE mode.

2.2.5 ITU G.703 64-kbps Co-directional Interface Module (ME266C)

The 64-kbps co-directional interface specified by ITU G.703 includes only one transmit pair and one receive pair. To avoid the need for additional pairs, the line signal waveform specified by G.703 for the 64-kbps co-directional interface includes timing and framing information.

By using appropriate signal-processing circuits, it is possible to recover the original data and clock signals from the received signal.

Thus, the receive path of the G.703 64-kbps co-directional internal module always operates on the clock signal recovered from the received line signal. The clock signal used by the module transmit path can be selected by means of a jumper.

The jumper has two positions:

- INT—the transmit clock is derived from an internal oscillator. **Figure 2-3** shows the flow of timing signals with internal timing.

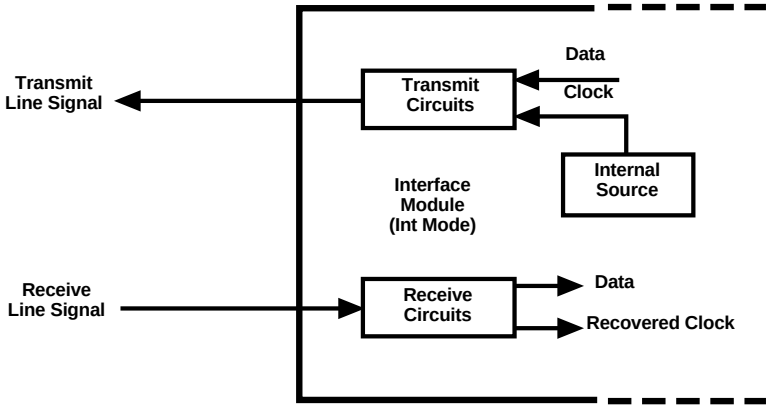

Figure 2-3. Flow of timing signals for INT mode.

- LBT—the transmit clock is locked to the recovered receive clock (this mode is called "loopback timing"). **Figure 2-4** shows the flow of timing signals with loopback timing.

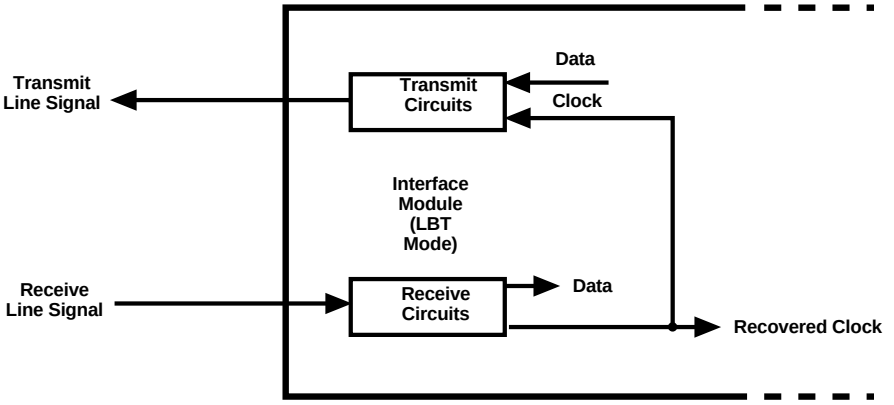

Figure 2-4. Flow of timing signals for LBT mode.

2.2.6 ITU 1.544- and 2.048-Mbps Interface Modules (ME268C and ME267C)

The ITU G.703 1.544-Mbps and 2.048-Mbps interface modules have four-wire interfaces (one pair for the transmit line and one pair for the receive line). The line signal (which uses B8ZS coding for the G.703 1.544-Mbps interface and HDB3 for the 2.048-Mbps interface) contains sufficient timing information to allow the recovery of the clock signal from the received data. The modules are transparent to any framing of the G.703 signals (which means they do not comply with ITU G.704).

Thus, the receive path of the G.703 1.544 Mbps and 2.048 Mbps interface modules always operates on the clock signal recovered from the received line signal. The clock signal used by the module transmit path can be selected by means of a jumper. The jumper has three positions:

- INT—the transmit clock is derived from an internal oscillator. **Figure 2-3** in **Section 2.2.5** shows the flow of timing signals with internal timing.
- LBT—the transmit clock is locked to the recovered receive clock. **Figure 2-4** in **Section 2.2.5** shows the flow of timing signals with loopback timing.
- EX—the transmit clock is locked to the clock signal provided by the receive path of the other interface module installed in the Modular Modem Eliminator. **Figure 2-5** shows the flow of timing signals for external timing.

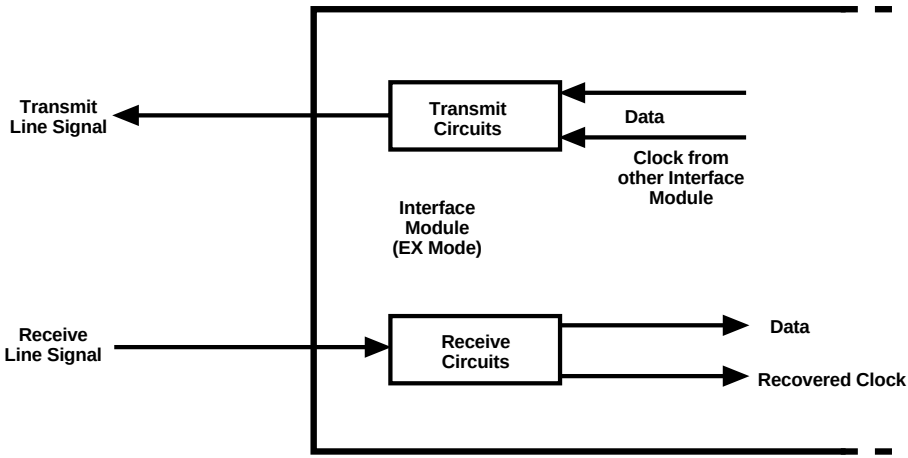

Figure 2-5. Flow of timing signals for EX mode.

2.2.7 General Characteristics

The Modular Modem Eliminator is a compact unit, intended for installation on a desktop or shelf. An adapter kit for mounting in 19" racks is available (part number RM518). The Modular Modem Eliminator is powered from 115-VAC (ME260A) or 230-VAC (ME260AE). Its power consumption is very low.

2.3 Applications

This section provides a description of the functions performed by the Modular Modem Eliminator. For illustration purposes, this section includes typical diagrams of interface signals flow. The signal names used on these diagrams are in accordance with the conventions that apply to the RS-232 interface; for information on the signals corresponding to other interface standards, refer to the interface-conversion table in **Appendix A**.

2.3.1 Interface-Converter Applications

Typical interface-converter applications for the Modular Modem Eliminator are:

- Connection of a DTE to a DCE that has a different interface. Any combination of DTE and DCE interfaces can be supported, by installing the appropriate type of plug-in interface modules in the Modular Modem Eliminator.

In a typical application, a Modular Modem Eliminator could be used to connect a V.35 host port to an X.21 data network (**Figure 2-6**, for example). In this case, the Modular Modem Eliminator will be equipped with a V.35 plug-in module on the host side, and with an X.21 module on the network side. During the installation, the DCE/DTE switches of the plug-in modules are set in accordance with the function to be simulated by the Modular Modem Eliminator (DCE on the host side, DTE on the network side).

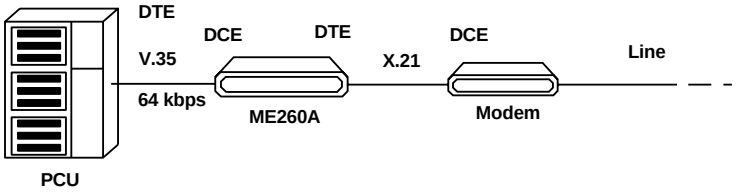

Figure 2-6. V.35 port to X.21 modem interface-converter application.

- Connection of a DTE to a 64 kbps co-directional G.703 1.544 Mbps or G.703 1.048 Mbps network or DTE. In a typical application, a Modular Modem Eliminator could be used to allow LAN interconnection via bridges using an E1 digital network, for example, even when the bridges do not have E1 interfaces. **Figure 2-7** shows an application where bridges with a V.35 interface communicate over the E1 digital network (transparent to 2.048 Mbps network with no need for framing).

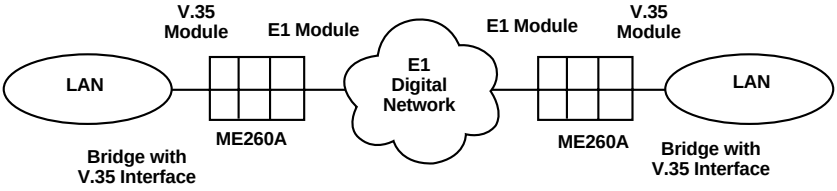

Figure 2-7. Two DTEs connection via E1 network.

2.3.2 Interfacing by General-Purpose Modules

Figure 2-8 shows a typical interface signals flow diagram for an interface converter application that uses two general-purpose interface modules.

In this application, the mode jumper of the interface module connected to the DTE must be set to the DCE position, and the mode jumper of the other module must be set to the DTE position. Interface-control signals are then transparently transferred from side to side, as shown in **Figure 2-8**.

NOTE

The data rate is determined by the DCE, therefore the DTE must operate with external timing.

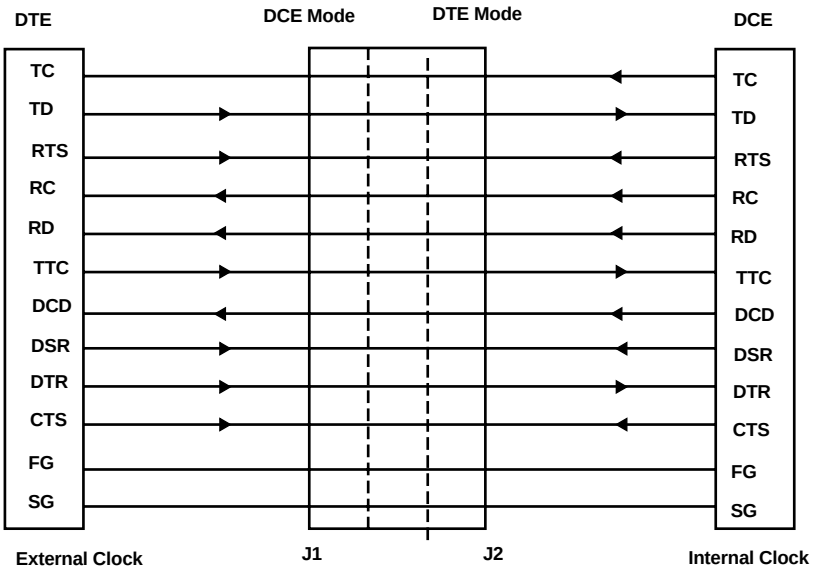

Figure 2-8. Typical interface-signal flow diagram (two general-purpose interface modules).

2.3.3 Interfacing with 64-kbps Co-directional Interface Module (ME266C)

Figure 2-9 shows a typical interface-signal flow diagram for an interface-converter application that uses a 64-kbps co-directional interface module in conjunction with a general-purpose interface module. This application allows the transfer of data to and from the DTE through a 64 kbps line.

In this application, the mode jumper of the UCI interface module connected to the DTE must be set to the DCE position. The DTE must use external timing. The jumper of the 64-kbps co-directional interface module is set in accordance with the system timing requirements:

- LBT—used to lock the DTE timing to the recovered lock signal. This setting is suitable for "tail-end" applications, where the DTE is connected through the Modular Modem Eliminator to a data network that includes an accurate timing source.
- INT—used to lock the DTE timing to the internal clock source of the 64-kbps co-directional interface module.

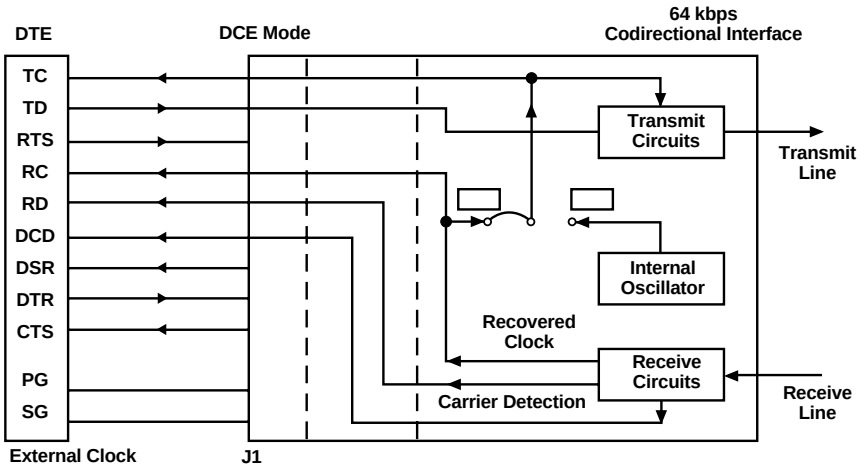

Figure 2-9. 64-kbps codirectional module (interface-converter application).

2.3.4 Interfacing with T1 or E1 Interface Module

Figure 2-10 shows a typical interface-signal flow diagram for an interface converter application that uses a T1 or E1 interface module in conjunction with a general-purpose interface module. This application allows the transfer of data to and from the DTE—for example, a bridge or a data multiplexor, through a T1 or E1 line.

In this application, the mode jumper of the interface module connected to the DTE must be set to the DCE position.

The DTE must use external timing. The jumper of the T1 or E1 interface module is set in accordance with the system timing requirements:

- LBT—used to lock the DTE timing to the recovered lock signal. This setting allows locking the DTE timing to the accurate timing provided by the T1 or E1 network. The DTE must then use external timing.
- INT—used to lock the DTE timing to the internal clock source of the T1 or E1 interface module. The DTE must use external timing.
- EX—used to lock the transmit timing of the T1 or E1 interface module to the DTE timing. In this case, the equipment at the remote end of the T1 or E1 link must use loopback timing.

The EX setting is suitable for applications that require locking the timing of the remote equipment to the timing of the local DTE—for example, when the local DTE uses internal timing, or is connected to an accurate timing source that must be propagated to the remote end.

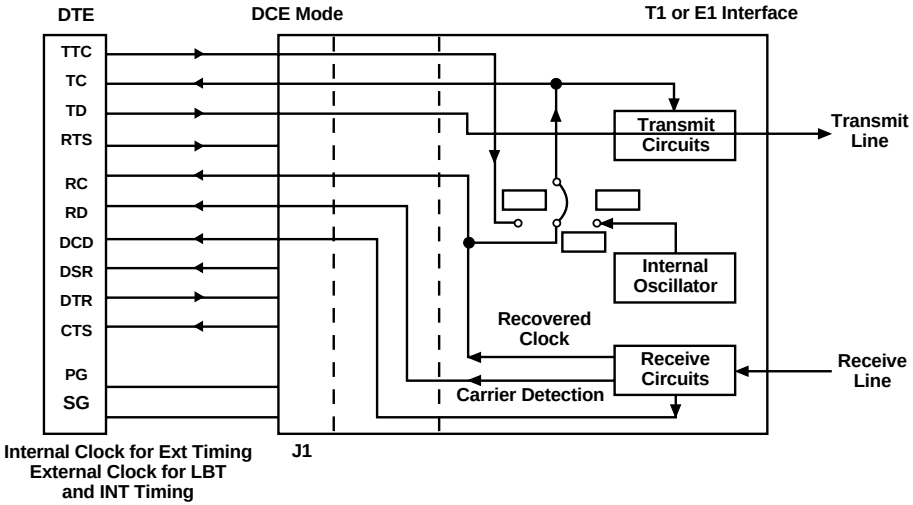

Figure 2-10. T1/E1 interfacing modules (interface-converter application).

2.3.5 Modem-Eliminator Applications

In modem-eliminator applications, the Modular Modem Eliminator is used as a replacement for two synchronous modems to connect two DTEs. The DTEs can have different interfaces. This mode is used when both sides have general purpose interfaces (G.703 interface modules include internal clock source).

When using general-purpose interface modules, the distance between the DTEs and the Modular Modem Eliminator is according to the relevant interface standard.

General Application Considerations

In a typical application, the Modular Modem Eliminator could be used to connect communication ports of two hosts (**Figure 2-11**).

Plug-in interface modules are installed in the Modular Modem Eliminator to match the interface used by each DTE. Since the Modular Modem Eliminator emulates modems on both sides, the mode switches on the two interface modules must be always set to the DCE position. To permit half-duplex operation, the Modular Modem Eliminator has two carrier-control jumpers, designated CARRIER-1 and CARRIER-2. Each jumper controls the state of the DCD line in the corresponding interface:

- For full-duplex operation, the DCD lines must be always active (on). This corresponds to the ON position of the jumpers.
- For half-duplex operation, the DCD line on one interface must follow the state of the RTS line on the other interface. This corresponds to the CNTRL position of the jumpers.

In addition, it is possible to introduce a delay between the activation of the RTS line of one interface and the activation of the CTS line of the same interface. The delay is determined by an additional pair of jumpers, DELAY-1 and DELAY-2 (one for each interface). The available delay settings are 0, 6, and 51 msec.

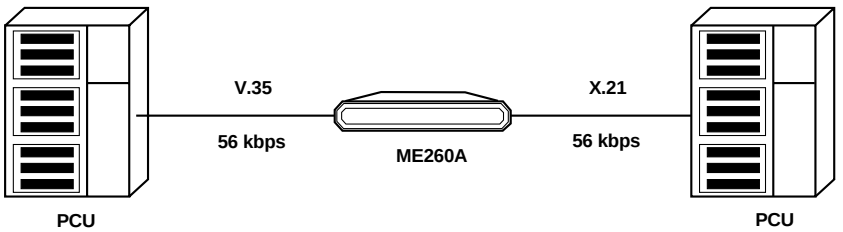

Figure 2-11. Typical modem-eliminator application.

Timing Modes

When set for operation in the modem eliminator configuration, the Modular Modem Eliminator offers two timing modes. The selection of the desired mode is made by an internal jumper:

- Internal (INT) timing: the clock signals for the two DTEs are provided by the internal clock oscillator of Modular Modem Eliminator. The data rate is set by means of the front-panel rate selector. In this case, the two DTEs must operate with external clock.

Figure 2-12 shows the flow of the clock signals in this mode, as well as the flow of interface control signals.

- External (EXT) timing: the Modular Modem Eliminator accepts an external clock signal from interface 1 and distributes this signal to interface 2. The data rate is then determined by the external clock signal. In this case, the DTE connected to interface 1 must operate with internal clock, and the DTE connected to interface 2 must operate with external clock.

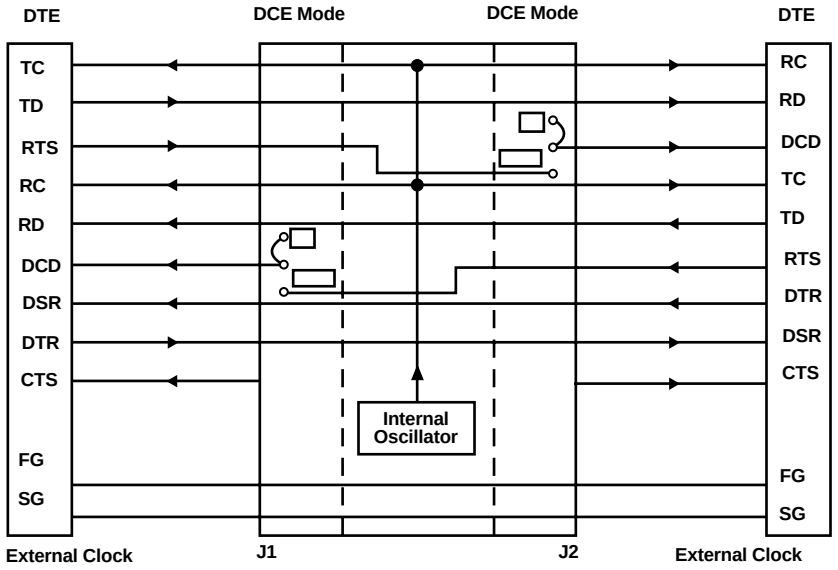

Figure 2-12. Modem eliminator application.

Figure 2-13 shows the flow of the clock signals in this mode, as well as the flow of interface control signals.

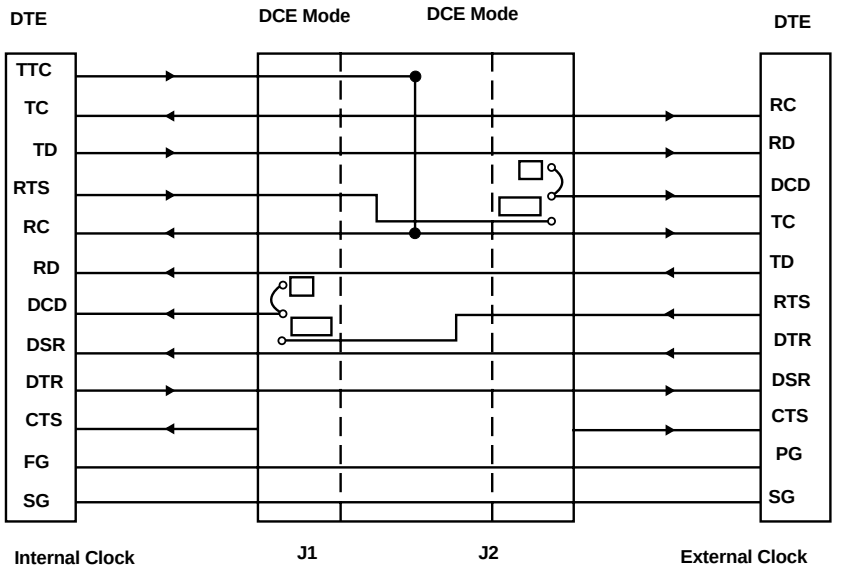

Figure 2-13. Modem-eliminator application (showing the flow of clock and interface-control signals in the EXT timing mode).

2.4 Elastic-Buffer Applications

In a typical elastic-buffer application, the Modular Modem Eliminator connects two DCEs that operate at the same nominal data rate, but use different timing sources. This means that data bits are clocked into the Modular Modem Eliminator at a rate slightly different from the rate at which the data is clocked out. Typical elastic-buffer applications are transfer of data between the channels of two TDM data multiplexors connected to different networks (**Figure 2-14**), or connection of a terminal to a data multiplexor via a modem link provided by the national PTT administration or by an independent data carrier.

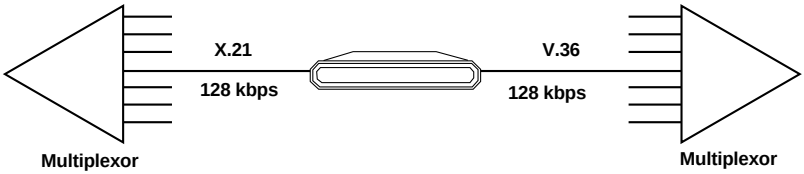

Figure 2-14. Typical elastic-buffer application.

To reduce the number of clock slippages, elastic buffers are used. An elastic buffer is a first-in, first-out (FIFO) buffer that operates with two clock sources: a write clock that clocks the data in, and a read clock that clocks the data out.

The Modular Modem Eliminator has two independent 256-bit buffers, one for each direction of data transmission. **Figure 2-15** on the next page shows data flow through the Modular Modem Eliminator, and illustrates its connections to the data equipment.

When you power on the Modular Modem Eliminator, the buffers first fill with data to the center position (128 bits), then data read-out starts. Any difference between the write and read rate changes the number of bits stored in the FIFO. The FIFO can therefore absorb slight rate differences without losing any data bits. Eventually, however, the FIFO may overflow or underflow, causing loss of data. In practical cases, the overflow/underflow events are relatively rare; therefore, data loss is negligible. Upon overflow/underflow, the buffer is reset to the center position.

Appendix B provides a description of the FIFO operation and presents methods for calculating the rate of overflow/underflow events as a function of expected clock-rate difference.

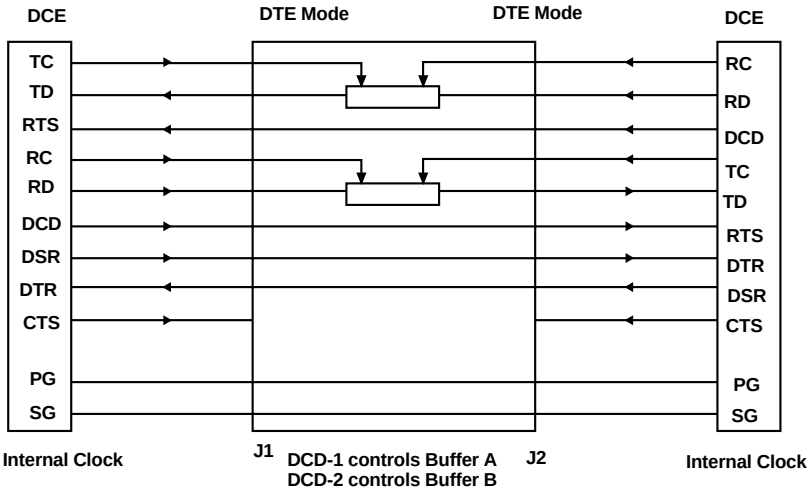

Figure 2-15. Elastic buffer application (data, check, and interface control signals diagram).

3. Installation

3.1 General

The Modular Modem Eliminator is designed for installation as a desktop unit, however, a rackmount kit is available (ordered separately, part number RM518).

Mechanical and electrical installation procedures for the Modular Modem Eliminator are provided in the following paragraphs. These procedures include the setting of internal jumpers, and the installation of interface modules.

3.1.1 What's Included in the Package

After unpacking the Modular Modem Eliminator, check all components for damage. Your package should include the following items. Call Black Box immediately at 724-746-5500 if any items are missing or if you suspect damage.

- Modular Modem Eliminator
- 115-VAC (with ME260A) or 230-VAC (with ME260AE) power supply
- This User Manual

The Modular Modem Eliminator accepts two Interface Modules, which are ordered separately (see **Section 2.2.2** for a description of available modules). Each Module package should include the following items:

- Interface Module
- This User Manual

3.1.2 Site Requirements

Power

The Modular Modem Eliminator should be installed within 5 feet (1.5 m) of an easily accessible grounded AC outlet capable of furnishing 115 VAC (for ME260A) or 230 VAC (for ME260AE).

Data Channel Connections

The Modular Modem Eliminator has two data channel interface connectors, one on each plug-in interface module.

Ambient Requirements

The ambient operating temperature of the Modular Modem Eliminator should be 32 to 122 °F (0 to 50 °C), at a relative humidity of up to 95%, non-condensing.

3.2 Configuration Information

3.2.1 General

Before installing the Modem Eliminator, set the internal jumpers as explained below. This paragraph describes how the internal jumpers function, to help you select the correct setting for your particular application, and gives you step-by-step instructions for changing the position of these jumpers.

In addition to setting the jumpers, you must set the internal switches on each interface module. Set the switches when you install the interface modules (**Section 3.2.4**).

3.2.2 Data Rate

The Modular Modem Eliminator data-rate selector is shown in **Figure 3-1**. Set this selector to the chosen data rate.

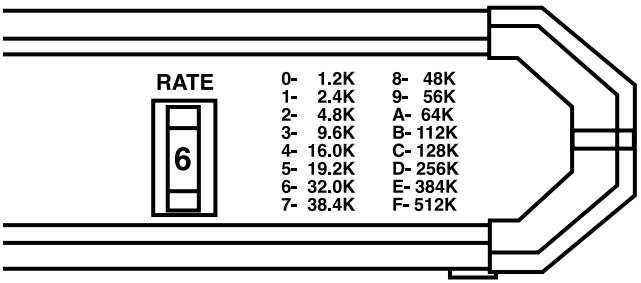

Figure 3-1. Front panel, data-rate selector.

3.3.3 Jumper Location and Functions

Modular Modem Eliminator jumpers are identified in **Figure 3-2**.

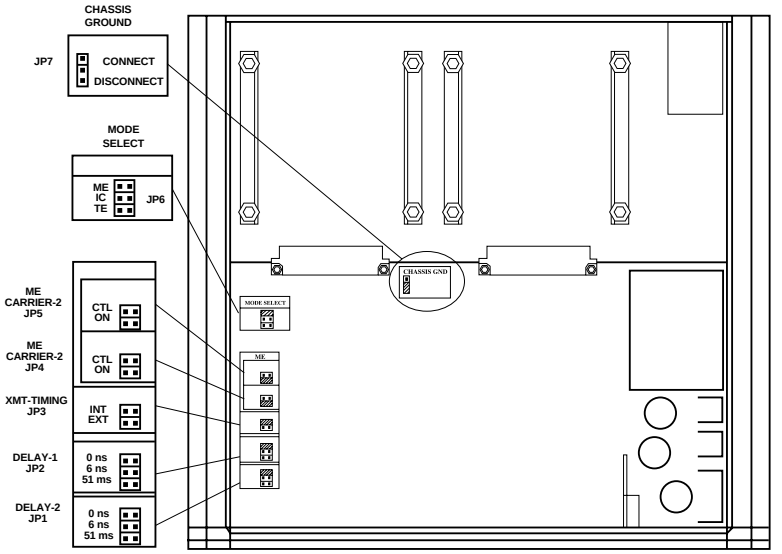

Figure 3-2. Jumpers.

CHASSIS GROUND SELECTION, JP7

- CONNECT—The signal ground is connected to chassis ground.
- DISCONNECT—The signal ground is not connected to the chassis ground.

The Modular Modem Eliminator is shipped with the jumper set at CONNECT.

MODE SELECT, JP6

Selects the Modular Modem Eliminator operating mode:

- ME—Modem eliminator
- IC—Interface converter
- TE—Elastic buffer

NOTE

The functions of all the following jumpers are used only in the ME (modem eliminator) mode.

CARRIER-2, JP5 (ME mode only)

- ON—The DCD line in connector J2 is continuously on.
- CTRL—The DCD line in connector J2 tracks the RTS line in connector J1.

The Modular Modem Eliminator is shipped with the jumper set at ON.

CARRIER-1, JP4 (ME mode only)

Same as JP5 for the DCD line in connector J1.

XMT TIMING, JP3 (ME mode only)

Selects the timing source in the ME mode:

- INT—Modular Modem Eliminator internal oscillator. The data rate is determined by the RATE selector.
- EXT J1—The transmit clock applied to connector J1. The data rate equals the clock rate.

The Modular Modem Eliminator is shipped with the jumper set at INT.

DELAY 1, JP2 (ME mode only)

Selects the delay between the activation of the RTS line in connector J1 and the activation of the CTS line in the same connector. The available selections are 0, 6, and 51 ms.

The Modular Modem Eliminator is shipped with the jumper set at 0 ms.

DELAY 2, JP1 (ME mode only)

Same as JP2 for connector J2.

3.2.4 Setting the Jumpers

CAUTION

Disconnect the unit from the power line before removing cover. Avoid adjusting, maintaining, and repairing the opened Modem Eliminator under voltage as much as possible. When inevitable, repairs under voltage should be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the Modem Eliminator may still be charged even after it has been disconnected from its source of supply.

To change jumper setting, follow these steps:

1. Disconnect the AC power cable from the mains.
2. Unscrew the screw fastening the top cover of the Modular Modem Eliminator (located at the rear), and remove the cover.
3. Identify the jumpers according to **Figure 3-2** in **Section 3.2.3**.
4. Install the jumpers in the desired positions.
5. Reinstall the top cover.

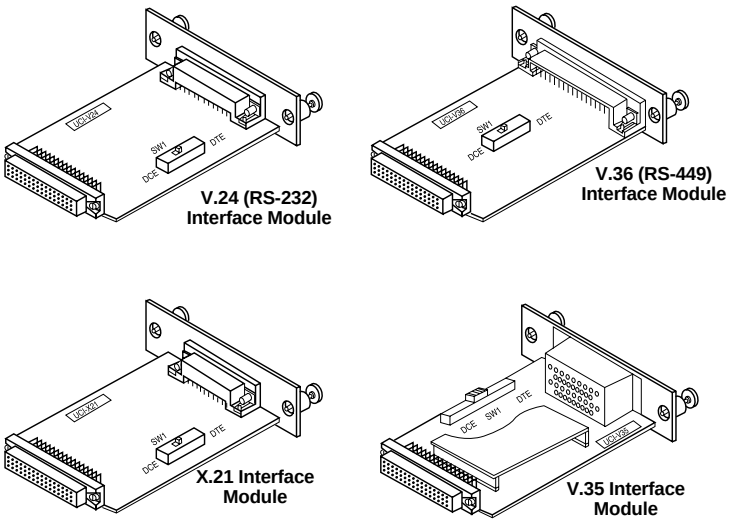

Figure 3-3. Interface modules (int. settings).

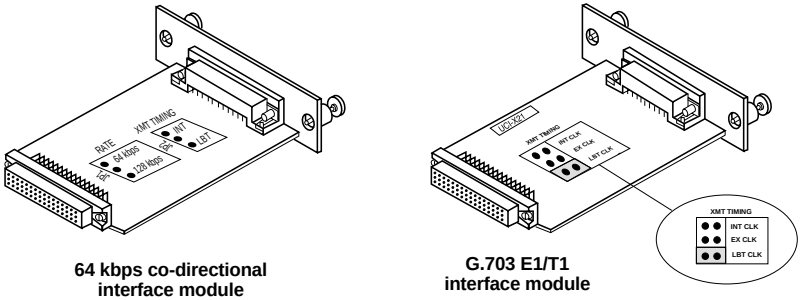

Figure 3-4. G.703 interface modules.

3.3 Configuring Interface Modules

3.3.1 General-Purpose Interface Modules

Each general-purpose interface module has a DTE/DCE selector, designated SW1. **Figure 3-3** in **Section 3.2.4** shows the position of the selector on each module, as well as the location of the module-type marking. Set the switch in accordance with the function implemented by the attached equipment.

3.3.2 ITU G.703 Interface Modules

The ITU G.703 interface modules include jumpers that select the source of the transmit clock signal. **Figure 3-4** in **Section 3.2.4** shows the location of the jumpers.

G.703 64-kbps Co-directional Interface Module

The jumper that selects the source of the transmit clock has two positions:

- INT—the transmit clock is derived from an internal oscillator.
- LBT—the transmit clock is locked to the recovered receive clock (this mode is called "loopback timing").

The jumper that selects the data rate has two positions:

- 64 kbps—the module receives and transmits at 64 kbps.
- 128 kbps—the module receives and transmits at 128 kbps (not according to the G.703 co-directional standard).

G.703 T1 and E1 Interface Modules

The jumper that selects the source of the transmit clock has three positions:

- INT—the transmit clock is derived from an internal oscillator.
- LBT—the transmit clock is locked to the recovered receive clock.
- EX—the transmit clock is locked to the clock signal provided by the receive path of the other interface module installed in the Modular Modem Eliminator.

3.4 Installing Interface Modules

As shown in **Figure 3-5**, the interface modules are held in place by two rails and are fastened by two captive screws to the rear panel.

- To remove a module, release the two captive screws and pull the module out.
- To install a module, carefully insert the module board into the rails and push in to mate the module connector, until resistance is felt. Tighten the two module screws.

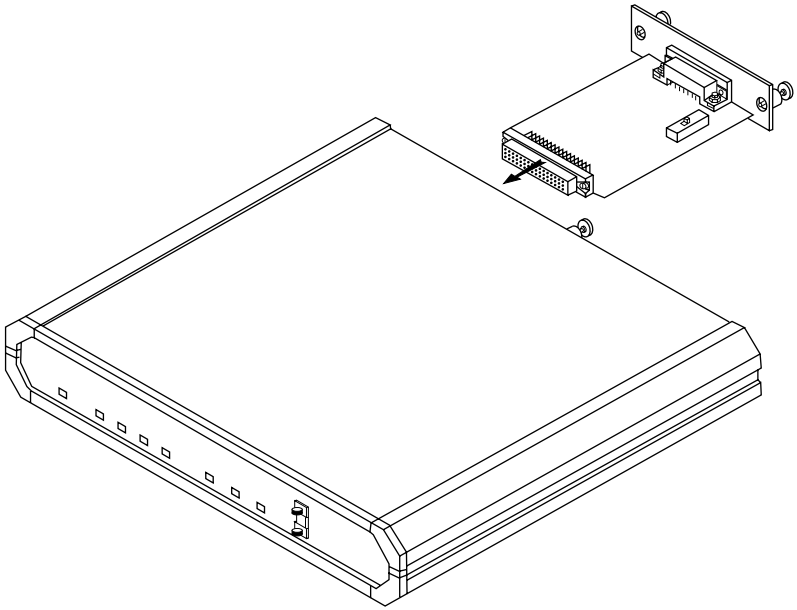

Figure 3-5. Installation of interface modules.

3.5 Connecting the Cables

3.5.1 Connector Location

Figure 3-6 identifies the connectors located on the rear panel of the Modular Modem Eliminator. For information on connector wiring, refer to **Appendix A**.

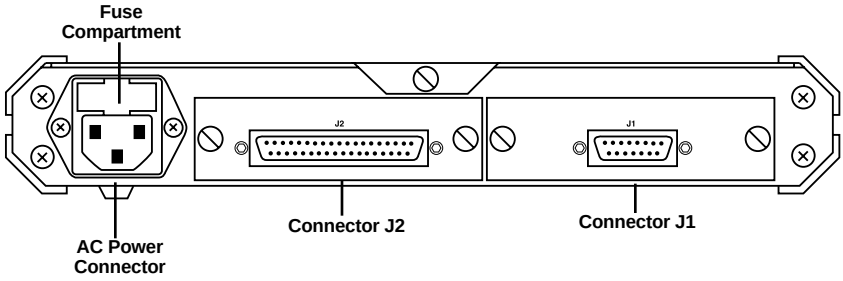

Figure 3-6. Rear Panel.

3.5.2 Data Connections

Refer to the installation plan and connect the data cables to the interface module connectors J1 and J2.

3.5.3 Power Connection

WARNING

When you plug in the Modem Eliminator, the protective earth terminals of this instrument must be connected to the protective ground conductor of the power cord. The plug must be inserted only in an outlet provided with a protective earth (grounding) contact. The protective action must not be negated by use of an extension cord without a grounding conductor. Make sure that only fuses of the required rating, as marked on the Modem Eliminator's rear panel, are used for replacement. Avoid using repaired fuses and short-circuiting fuse holders. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

AC power should be supplied to the Modular Modem Eliminator through the 5-foot (1.5-m) standard power cable terminated by a standard 3-prong plug. Connect the cable between the AC mains connector on the rear panel and a standard grounded AC outlet.

3.5.4 Grounding

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

4. Operation

4.1 Front Panel Control and Indicators

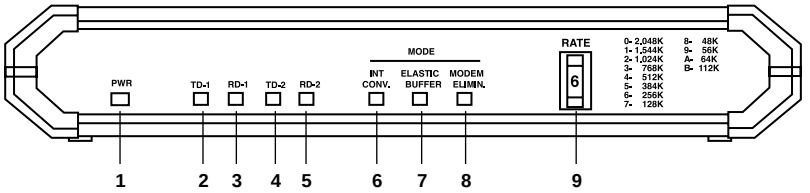

Figure 4-1. Front Panel.

Table 4-1 lists the functions of the indicators and the rate selector on the front panel.

Table 4-1. Controls and indicators.

No.	Control or Indicator	Function
1	PWR indicator	Lights when the Eliminator is powered
2	TD-1 indicator	Indicates activity on the transmit data line in connector J1
3	RD-1 indicator	Indicates activity on the receive data line in connector J1
4	TD-2 indicator	Indicates activity on the transmit data line in connector J2
5	RD-2 indicator	Indicates activity on the receive data line in connector J2

Table 4-1 (continued). Controls and indicators.

No.	Control or Indicator	Function
6, 7, 8	MODE indicators	The indicator corresponding to the selected operating mode lights: INT CONV — Interface converter ELASTIC BUFFER — Elastic buffer MODEM ELIM — Modem eliminator
9	RATE selector	16-position rotary data selector, activated via two buttons. Used only in the modem-eliminator mode, when operating on the internal clock. Available rates are marked on the front panel.

4.2 Operating Instructions

4.2.1 Power-On Procedure

The Modular Modem Eliminator starts operating as soon as AC power is applied. Always connect the cable first to the Eliminator's power connector, and then to the mains outlet.

The PWR indicator and the appropriate MODE indicator light when AC power is connected.

4.2.2 Operating Instructions

After being prepared according to **Chapter 3**, the Modem Eliminator operates unattended. For operation as a modem eliminator with timing provided by the internal oscillator, you must set the data rate: press the buttons of the RATE selector until the code corresponding to the desired data rate appears in the window.

4.2.3 Normal Indications

During data transfer, the TD and RD indicators light.

4.2.4 Power-Off Procedure

Disconnect the AC power cable from the mains outlet.

5. Troubleshooting

5.1 Things To Try

In case a problem occurs, perform the following checks:

- Check that the PWR indicator lights. If not:

- Check that both ends of the AC power cable are properly connected.

- Disconnect the AC cable from both ends and check the Modem Eliminator's fuse (located in the AC power connector). If the fuse is blown, replace it with a fuse of proper rating.

- Replace the Modular Modem Eliminator.

- Check that the appropriate MODE indicator lights. If not, set the internal MODE SELECT jumper to the correct position.

- Check that the internal jumpers and the interface module internal switches are set to the correct positions. See **Sections 3.2.3** and **3.2.4**.

- Check that the cables between the Modular Modem Eliminator and the attached equipment are properly connected.

5.2 Calling Black Box

If you determine that your Modular Modem Eliminator is malfunctioning, *do not attempt to alter or repair the unit.* It contains no user-serviceable parts. Contact Black Box Technical Support at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem;

- when the problem occurs;

- the equipment involved in the problem;

- any particular application that, when used, appears to create the problem or make it worse; and

- the results of any testing you've already done.

5.3 Shipping and Packaging

If you need to transport or ship your Modular Modem Eliminator:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the unit for repair, please include all parts of its external power supply. If you are returning the unit, please include everything you received with it. Before you ship the unit back to Black Box for repair or return, contact us to get a Return Authorization (RA) number.

Appendix A: Interface Data

A.1 General-Purpose Modules

Table A-1 lists the line functions in the interface connectors of the Modular Modem Eliminator's general-purpose plug-in modules.

Table A-1. Plug-in module's interface connectors (line functions).

	Description	Abbr.	Direction of Signal to	EIA RS-232C RS-232D Circuit	ITU Pin	V.35 V.24 V.35 V.36	V.36 (RS-449) Pin Type	Pin	Wire No.	Circuit	ITU X.21 Abbr.	Circuit Name	Pin
Ground	Protective Ground (Shield)			AA	1	101	A	1				Shield	1
	Signal Ground (Common return)	SG		AB	7	102	B	19		SG	G	Ground	8
	DTE Common Return		DCE			102a		37		SC			
	DCE Common Return		DTE			102b		20		RC			
Data	Transmitted Data	TD	DCE	BA	2	103	P(A) Bal S(B)	4 22	A B	SD	T	Transmit	2(A) 9(B)
	Received Data	RD	DTE	BB	3	104	R(A) Bal T(B)	6 24	A B	RD	R	Receive	4(A) 11(B)
Control	Request to Send	RTS	DCE	CA	4	105	C Unbal	7 25	A B	RS	C	Control	3(A) 10(B)
	Clear to Send	CTS	DTE	CB	5	106	D Unbal	9 27	A B	CS			
	Data Set Ready	DSR	DTE	CC	6	107	E Unbal	11 29	A B	DM			
	Data Terminal Ready	DTR	DCE	CD	20	108/2	H Unbal	12 30	A B	TR			
	Data Carrier Detect	DCD	DTE	CF	8	109	F Unbal	13 31	A	RR	I	Indication	5(A) 12(B)

Table A-1 (continued). Plug-in module's interface connectors (line functions).

	Description	Abbr.	Direction of Signal to	EIA RS-232C RS-232D Circuit	ITU V.35 V.24 V.35 V.36 Pin		V.36 Pin Type	Pin No.	Wire	Circuit	ITU X.21 Abbr.	Circuit Name	Pin
	Ring Indicator	RI	DTE	CE	22	125	J Unbal	15		IC			
Timing	Transmit Clock (from DTE)	TTC	DCE	DA	24	113	U(A) Bal W9B)	17 35	A B	TT			
	Transmit Clock (from DCE)	TC	DTE	DB	15	114	Y(A) Bal AA(B)	5 23	A B	ST	S	Signal Timing	
	Receive Clock (from DCE)	RC	DTE	DD	17	115	V(A) Bal X(B)	8 26	A B	RT			6(A) 13(B)
Tests	Remote Digital Loopback V.54/2	RLB	DCE	RL	21	140	HH Unbal	14		RL			
	Local Analog Loopback V.54/3	LLB	DCE	LL	18	141	JJ Unbal	10		LL			
	Test Mode	TM	DTE	TM	25	142	KK Unbal	18		TM			
	Sources		EIA RS-232C RS-232D		ISO 2110	CCITT V.24	ISO V.35 2593	ISO 4902	RS-499		ISO 4903	(X.21/X.27)	

A.2 ITU G.703 Balanced Interface Modules

The G.703 balanced interface modules have a 15-pin D-type female connector, wired as shown in **Table A-2**.

Table A-2. CCITT Rec. G703 pin connection.

Pin	Function
1	Transmit line
2	Not used
3	Receive line
4 through 8	Not used
9	Transmit line
10	Not used
11	Receive line
12 through 15	Not used

Appendix B: Calculation of Elastic Buffer Over/Underflow Rate

B.1 General

An important consideration in many applications is bit count integrity (BCI). In synchronous data transmission systems, bits can be "lost" or "gained" when the receive clock rate is not equal to the transmit rate. "Loss" or "gain" is unacceptable, and can cause disruptions lasting several seconds, especially in systems using data multiplexors, or in secure systems protected by the DES or other encryption algorithms.

Bits are "lost" when the receive clock is slightly slower than the transmit clock, and are "gained" in the reverse case. The generic designation for these effects is "slippage." A measure of slippage severity is the slippage rate—the number of slippage events per time interval.

B.2 Slippage Rate without Buffers

When no buffers are used, a slippage event occurs when a bit is lost/gained. The slippage rate is nominally equal to the difference in clock rates, times the data rate (bits/second).

For example, when the clock accuracy is 100 parts per million (ppm), the worst-case clock difference is 200 ppm. Therefore, at a data rate of 64 kbps:

Slippage Rate = $64 \times 10^{3} \times 200 \times 10^{-6}$=12.8 bits/second

B.3 Slippage Rate with Buffers

When FIFO buffers are used, slippage occurs only when the number of bits read from the FIFO differs from the number of bits written into it.

The FIFO buffers are preset to the middle of their capacity. The Modular Modem Eliminator has 256-bit buffers, so the buffers are preset to 128 bits. An overflow or underflow event will therefore take place only after approximately 128 bits are "lost" or "gained," respectively.

Under the conditions assumed in the example of **Section B.2**, the slippage rate decreases to one in every 10 seconds. Although this is far from ideal, it means that in a half-duplex application, messages having a length of up to 640 kb can be safely

transmitted. Other conditions of interest are multiplexed 64-kbps channels transferred by digital multiplexors.

When the digital multiplexors are synchronized by secondary atomic clocks, the expected worst-case clock rate difference is approximately 3×10^{-10}. In this case, the slippage rate achieved by the Modular Modem Eliminator is given by:

Slippage Rate = $64 \times 10^{3} \times 3 \times 10^{-10} \times 1/128 = 1.5 \times 10^{-7}$ bits/second

This is equal to one slippage every 1851 hours, or one slippage every two and half months.

When making accurate calculations of bit slippage, additional second-order effects must be taken into consideration, namely low-frequency clock jitter (clock "wander"). The clock wander usually does not exceed a peak value of several bit intervals. Therefore, this is only a small fraction of the Modem Eliminator buffer size and does not significantly change the slippage rate.

NOTES

NOTES

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